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Floods on Big Creek in the Vicinity of La Follette, Tennessee

Flood Report
TVA/OECD/CD-81/23
September 1981

TENNESSEE VALLEY AUTHORITY

TENNESSEE VALLEY AUTHORITY

Office of Economic and Community Development

FLOODS ON BIG CREEK IN THE VICINITY OF LA FOLLETTE, TENNESSEE

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TVA/OECD/CD - 81/23

Knoxville, Tennessee

September 1981

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FLOODS ON BIG CREEK IN THE VICINITY OF LA FOLLETTE, TENNESSEE

INTRODUCTION

In recent years, local officials of La Follette have recognized a need for updated flood information to assist in planning for future development in the Big Creek floodplain and to meet the minimum requirements of the National Flood Insurance Program (NFIP). In May 1979 the city requested TVA's assistance in obtaining the necessary information and data to properly administer its floodplain management program. Following discussions with city officials and a planning representative from the Tennessee State Planning Office, TVA agreed in September 1980 to furnish this information.

This study, like all previous flood studies for the city of La Follette, pertains to flooding along Big Creek, the only stream having an identified flood hazard potential, which presents a major threat to life and property within the city limits.

The information and technical data contained herein provide the basis for the development of revised flood damage prevention regulations and for future consideration of other floodplain management measures. This report, along with further TVA guidance, will enable the city to have a floodplain management plan complete with flooded area and floodway maps, flood profiles, technical reference data, and ordinances which will meet all the requirements for participation in the NFIP. In addition to providing the necessary technical data, TVA will continue to respond to requests for guidance in understanding and administering the technical aspects of a floodplain management program.

STUDY AND SCOPE

PURPOSE OF REPORT

The purposes of this flood study for La Follette are to:

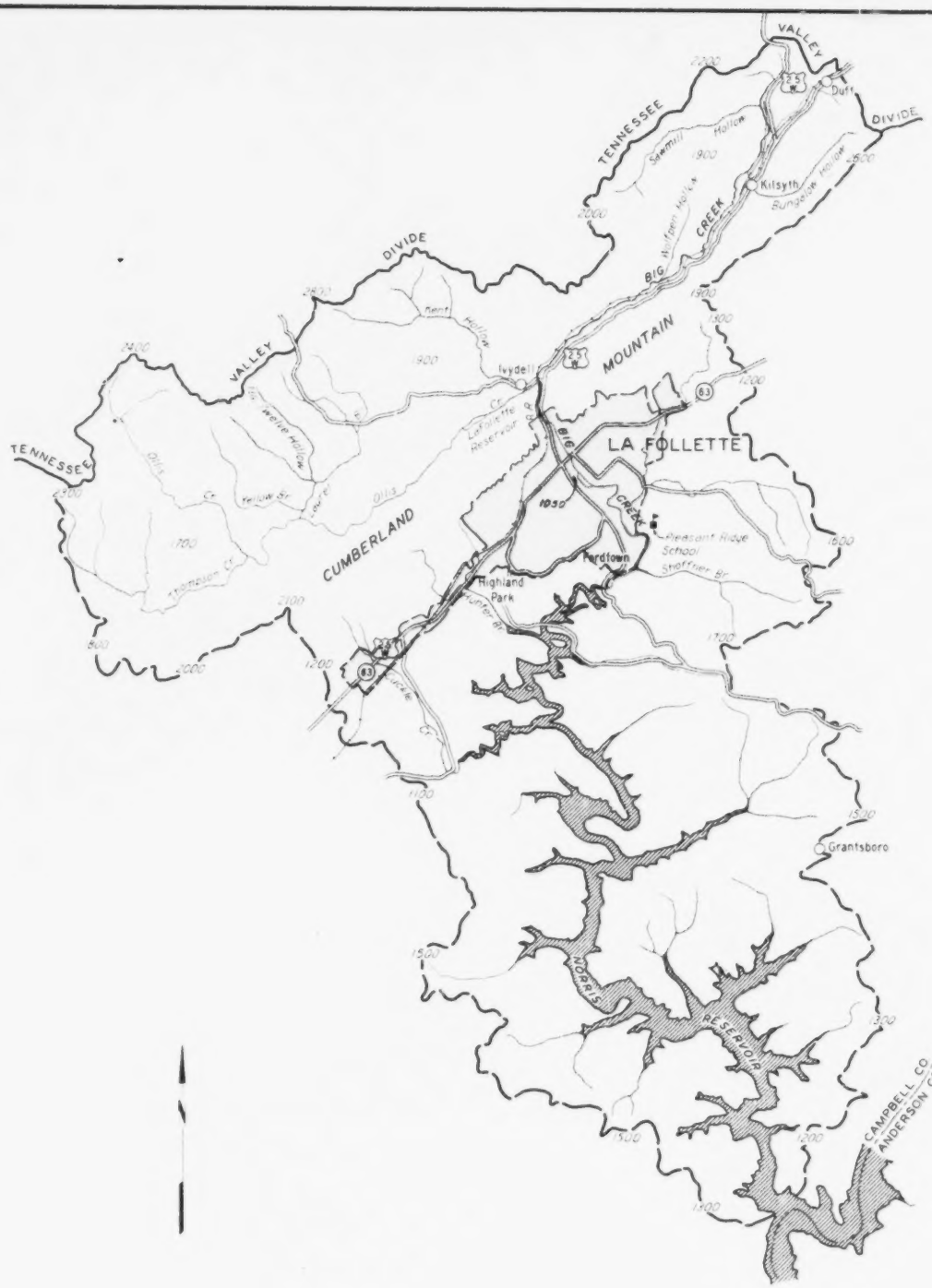
1. Respond to the city's request for assistance.
2. Review and briefly explain past flood studies and materials furnished to the city.
3. Describe Big Creek's watershed, floodplain, and flood history and identify that portion of the floodplain in detail.
4. Provide the technical data needed as the foundation for development of the city's floodplain management program.

WATERSHED DESCRIPTION

The Big Creek watershed (shown on plate 1) begins in the Cumberland Mountains in narrow stream valleys between steep ridges rising as much as 1,700 feet above the streambed. The watershed upstream from the city is mainly forested and is drained by two major streams, Big and Ollis Creeks. An area of 24.7 square miles is drained above the Central Avenue (Tennessee Highway 63) bridge in La Follette (Big Creek mile 19.3).

Just upstream from the La Follette corporate limits, Big Creek exits the narrow valleys, and the floodplain spreads out to widths ranging from approximately 300 to 2,000 feet. Just downstream from the La Follette corporate limits, Big Creek flows into TVA's Norris Reservoir. Development is regulated on lands adjacent to the reservoir to be compatible with reservoir operations for flood control and other purposes and, therefore, flood risks are minimized on these lands.

PLATE I



REACH COVERED BY THIS REPORT

TENNESSEE VALLEY AUTHORITY
OFFICE OF ECONOMIC AND COMMUNITY DEVELOPMENT

BIG CREEK WATERSHED

Scale 0 1 2 3 Miles

AUGUST 1980

2A BEST DOCUMENT AVAILABLE

FLOODPLAIN DEVELOPMENTS

The majority of the developable portion of Big Creek's floodplain is contained within the corporate limits of La Follette. Much of the central business district and some residential areas are developed along both banks. Although there has been some new construction in the floodplain, most of the development is unchanged from that which existed in 1957 when TVA conducted its first detailed flood investigation of the city.

TVA's first flood report for La Follette, "Floods on Big Creek, La Follette, Tennessee" (reference 1), dated January 1958, provides a detailed description of the developments in the floodplain which, for the most part, still reflects present-day conditions. Plate 3 shows the 100- and 500-year flood boundaries and the development within these floodplains as of 1973 when the base map was prepared. A field check of stream conditions and new development was completed in 1980 to update the base map.

The stream reach covered in this report is essentially the same as the limits previously studied. Big Creek enters the corporate limits of La Follette at stream mile 19.97 and leaves the city at stream mile 16.89. This 3.08-mile reach of Big Creek falls within the city's jurisdiction for floodplain regulation and was studied in detail to provide the technical flood data and information necessary for updating the city's floodplain management program.

REVIEW OF HISTORIC FLOODS

There are no stream gage records on Big Creek to provide historic flood information. For the 1958 flood study, TVA conducted a flood history search and was unable to obtain any information preceding the March 1929

flood. Notable floods at La Follette occurred during March 1929, February 1939, January 1946, February 1948, May 1950, and March 1955.

The March 1929 flood is the maximum known flood on Big Creek at La Follette, and nearly every business in the central business district suffered some damage. The May 1950 flood is the second largest known flood, having an estimated peak discharge only slightly less than the March 1929 flood. Considerable damage to the central business district also resulted from this flood. TVA's 1958 flood report gives a detailed description of these flood occurrences and resulting damages. High water marks for the 1929 and 1950 floods, at mile 19.69, midway between U.S. Highway 25W and Aspen Street, showed these floods reached elevations 1073.9 and 1073.7, respectively.

In November 1980 TVA conducted another investigation of floods which occurred since publication of the 1958 flood report. This investigation revealed that there have been no damaging floods on Big Creek since May 1950. There have been at least two occasions, March 1973 and April 1977, when a few residents along the left bank between Central Avenue and Beech Street were evacuated due to threatening floodwaters. No damages were sustained, and there are indications that the flood threats were due to local drainage problems rather than overflow from Big Creek. Following the February 1948 and May 1950 floods, the Big Creek channel was deepened and improved through the central business district. The majority of the local people interviewed in 1980 regarding past floods feel that the channel modifications of the late 1940's and early 1950's have alleviated the city's flood problems. Thirty years without a major flood has created a false sense of security among many local citizens and merchants concerning the potential for another major flood at La Follette.

PAST FLOOD STUDIES

TVA's January 1958 flood report entitled "Floods on Big Creek, La Follette, Tennessee," documented flood history and contained descriptive information on two calculated floods, the regional and the maximum probable floods. This report was prepared in response to the city's request for flood information which would be useful in administering the State and local program for city planning and development.

In October 1959 TVA prepared high water profiles which included the regional flood as a supplement to the 1958 flood. A proposed floodway map based on the maximum probable flood was also prepared at this time. The city requested this information in order to develop and adopt local floodplain regulations.

In October 1971 the Federal Insurance Administration (FIA) (now a part of the Federal Emergency Management Agency) published a flood insurance study for La Follette containing data on the 10-, 25-, and 100-year floods. This report was one of the earliest endeavors to present flood data based on a statistical likelihood of occurrence. The Federal Emergency Management Agency (FEMA) uses the 100-year flood as a national standard for flood insurance and floodplain management requirements.

In November 1976 FIA published a flood insurance rate map for La Follette refining some of the previously published information. Used in conjunction with flood hazard rate tables, this map established the rates for flood insurance premiums.

REPRESENTATION OF FLOOD DATA

A flood is normally described by data representing its elevation and boundaries at a specified location along the stream. Floodway limits,

which are used for regulatory purposes, are not tied to topography and are described solely by horizontal distances measured from prominent features and references.

The flood information in this report is in the following format:

1. Flood elevations are shown on flood profiles (plates 4 and 5).
2. Flooded area limits are shown on flooded area maps (plates 2 and 3).
3. Floodway limits are shown on flooded area with proposed floodway maps (plates 2A and 3A).

COMPUTED FLOODS

To assist the city of La Follette in administering its floodplain management program, flood discharges and elevations have been computed for the 100- and 500-year floods. The data and plates included in this report have been prepared by the Flood Hazard Analysis Branch, Division of Water Resources, Office of Natural Resources.

HYDROLOGY

Computed flood discharges for Big Creek are based on analyses of stream gage records from similar watersheds in the region. All stream gage analyses follow standard procedures outlined in Guidelines for Determining Flood Flow Frequency (reference 2).

One-Hundred-Year Flood

The 100-year flood is defined as the flood with a 1-in-100 (1-percent) chance of being equaled or exceeded in any given year. While this flood may occur at any time, there is a 26-percent chance of its occurrence in a normal

30-year mortgage period. The 100-year flood profile on Big Creek under existing channel conditions is approximately equal to the March 1929 and May 1950 flood profiles. The 100-year flood is the minimum standard required by the FEMA for floodplain management purposes for those communities participating in the NFIP.

Five-Hundred-Year Flood

The 500-year flood is a rare event with a 1-in-500 (0.2-percent) chance of being equaled or exceeded in any given year. While this flood may occur at any time, there is a 6-percent chance of its occurrence in a 30-year period. The 500-year flood profiles on Big Creek under existing channel conditions would average approximately 2 feet higher than the March 1929, May 1950, and 100-year floods. The 500-year flood is provided as a guide for planning community and industrial development where risk of flooding must be reduced by providing an increased level of protection.

HYDRAULICS

The hydraulic characteristics of Big Creek were analyzed using the HEC-2N backwater program to compute the 100- and 500-year flood elevations at selected cross sections. These cross sections were field surveyed at bridges and other locations to accurately define the floodplain of Big Creek. The locations of cross sections used in the hydraulic analyses are shown on the flooded area maps (plates 2 and 3).

The flood profile is a plot of flood elevations versus the stream mile for the 100- and 500-year flood (plates 4 and 5). The elevations are shown in feet above mean sea level and the stream miles are measured from the mouth upstream. To create a flood profile, the computed elevations at each

consecutive cross section are joined with straight lines. Tabulations of the 100- and 500-year flood elevations and discharges for Big Creek are included in table 1.

The computed elevations are based on the assumption that bridges and other hydraulic structures remain open and unobstructed. The accumulation of debris under bridges during the time of flooding may raise the flood elevations higher than those shown on the stream profile. The flooded area maps (plates 2 and 3) show the areas that would be inundated by the 100- and 500-year floods.

Floodways

Encroachments on floodplains such as fills or structures reduce the flood-carrying and storage capacities of the floodplain and in most cases increase the danger of flooding in other areas. When considering development of floodplain lands, the economic gain which would result from the proposed development must be compared to the potential flood damage to both the proposed development and existing developments in the floodplain. Because the exclusion of all development from the floodplain is often excessively restrictive, the floodway-flood fringe concept was developed. Using this concept, the floodplain is divided into two areas--the floodway and the flood fringe. The floodway (as shown in the appendix) is the stream channel and that portion of the floodplain which must remain open and unobstructed to prevent a significant increase in flood elevations. To develop the floodway limits, imaginary "walls" are placed in the floodplain to confine the flow of floodwaters to only that area between the "walls" and, through the use of computer modeling, the location of these "walls" is adjusted until an acceptable increase in flood elevation is achieved. For La Follette the floodway is

Table 1

BIG CREEK PROFILE TABULATION

Mile	100-Year Flood Discharge (cfs)	100-Year Flood Elevation (Feet)	500-Year Flood Discharge (cfs)	500-Year Flood Elevation (Feet)
16.65 DS[1]	11,600	1010.3	16,100	1012.3
16.65 US[1]	11,600	1011.2	16,100	1013.1
16.86	11,600	1014.5	15,900	1016.7
17.23	11,400	1019.2	15,700	1021.2
17.48	11,300	1024.2	15,600	1027.1
17.73	9,800	1025.5	12,800	1028.2
18.25	9,500	1034.6	12,600	1036.3
18.55	9,400	1044.0	12,400	1046.3
18.66	9,400	1045.6	12,300	1047.9
18.72 DS	9,400	1047.7	12,300	1050.0
18.72 US	9,400	1048.1	12,300	1050.4
18.84	9,300	1048.6	12,300	1050.9
19.04	9,200	1050.8	12,100	1052.8
19.18 DS	9,100	1052.0	12,100	1053.7
19.18 US	9,100	1055.5	12,100	1056.4
19.20	9,100	1055.5	12,100	1056.4
19.29	9,100	1055.8	12,000	1056.4
19.33 DS	9,000	1056.6	11,900	1059.5
19.33 US	9,000	1062.2	11,900	1065.5
19.40	9,000	1062.8	11,900	1066.1
19.43	9,000	1063.3	11,900	1066.4
19.53 DS	8,900	1063.6	11,900	1066.4
19.53 US	8,900	1066.4	11,900	1068.5
19.58	8,900	1066.7	11,900	1068.8
19.65	8,900	1070.1	11,800	1073.0
19.73	8,800	1075.6	11,800	1077.0
19.88	8,800	1080.7	11,750	1082.9
19.89 DS	8,800	1080.9	11,750	1085.9
19.89 US	8,800	1087.4	11,750	1089.0
20.00	8,700	1092.3	11,600	1094.0

1. Downstream and Upstream at bridges.

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designed to carry the 100-year flood without causing more than a 1-foot rise in elevations. The floodway widths and elevations for Big Creek are shown in table 1A (see appendix). The flood fringe is the outer edges of the floodplain where development may be permitted by local ordinances if it is elevated above the 100-year flood elevation.

FLOODPLAIN MANAGEMENT

The need for floodplain management is widespread across the Tennessee River basin because the majority of usable floodplain land lies unprotected by flood control works and is vulnerable to destructive flooding. Social, economic, and environmental constraints in most cases prohibit the consideration of constructing major flood damage reduction facilities. Thus, the most viable alternative for reducing the trend of increasing flood damages is to regulate the use of floodplains. The success in carrying out the goals of floodplain management is dependent upon action by the local government and the cooperation of its citizens.

To be effective, floodplain management measures should perform the following functions:

1. Reduce or prevent future flood damages and the loss of life.
2. Promote wise use of the floodplain.
3. Reserve for the passage of floodwaters that area of the floodplain where damages and destruction are inevitable during a flood event that equals or exceeds the 100-year flood.
4. Increase the awareness of developers and users of the floodplain regarding the flood potential in the area.

NATIONAL FLOOD INSURANCE PROGRAM

Because of continuing floodplain development, resulting in increasing flood losses and the lack of affordable flood insurance, the U.S. Congress created the NFIP with the enactment of the National Flood Insurance Act of 1968. The program was broadened and modified with the passage of the Flood Disaster Protection Act of 1973.

Participation in the NFIP is offered to local communities (counties and incorporated towns and cities) on a voluntary basis. If the government body of a community chooses to participate, it must adopt and administer certain minimal floodplain management measures required by the NFIP regulations. In return, all residents of the community are eligible to purchase flood insurance. If a community chooses not to participate in the NFIP, its citizens are denied the opportunity to purchase flood insurance; and, additionally, any Federal program which offers other financial or disaster assistance for construction and reconstruction in the floodplain (such as water and sewer treatment plants and systems) is forfeited.

As viewed by Congress the NFIP is a program that over a long term will reduce annual flood losses through wise planning and utilization of the floodplain. The savings in taxpayer dollars spent on flood losses can help offset the federally supported program of providing property owners with flood insurance at affordable premiums. Also, wise use of floodplains should result in fewer flood insurance claims.

FEMA, which administers the NFIP, provides the following explanation on regulations.

FEMA regulations (54 CFR 60.1(d)) allow a community to adopt and enforce more restrictive elevation and floodway requirements than what is shown on the effective (official) Flood Insurance Rate Map. While FEMA encourages and supports the use of this more restrictive data, FEMA can not require the community to adopt and enforce data until so provided by the administrator through the publication of the revised data and maps by FEMA.

La Follette has chosen to participate in the NFIP and to base its floodplain management program on the minimum requirements for compliance, i.e., regulations based on the 1-percent-chance (100-year) flood.

The technical data and floodplain information contained in this report can be used by the city of La Follette to update its floodplain management program and regulations. It may be necessary for TVA to provide additional information and guidance to the city during the preparation of the ordinances required to accomplish the objectives of floodplain management.

USER'S GUIDE

To aid the user of this study in understanding the technical terms and data presented, TVA has prepared a document entitled "Guide for the Use of Technical Information and Data for Floodplain Management in the Tennessee River Basin," dated October 1980. Copies of this document are available upon request from TVA.

DEFINITIONS OF TERMS

Computed Flood - An estimated future flood based on a hydraulic analysis of the potential storm runoff from an area and flow of water through the floodplain.

Effective Stream Mileage - The point along the centerline of the stream channel which has the same flood elevation as a specified location in the floodplain.

Flood - A temporary rise in water levels or an accumulation of water runoff, resulting in inundation of areas not ordinarily covered by water.

1-Percent-Chance (100-year) Flood - A flood having 1 chance in 100 of being equaled or exceeded in any 1-year period.

0.2-Percent-Chance (500-year) Flood - A flood having a 0.2 chance in 100 (1 chance in 500) of being equaled or exceeded in any 1-year period.

Flood Boundary - The outermost limit the waters of a flood of a certain magnitude will reach.

Flood Elevation or Water Surface Elevation - The height (expressed in relation to mean sea level) reached by floods or channel flows of various magnitudes.

Flood Fringe - The area within the flood plain which is outside of the floodway.

Flooded Area Map - A map which shows the horizontal flood limits for one or more floods.

Floodplain - Any land area susceptible to inundation by water from any source including, at a minimum, that area subject to a 1-percent or greater chance of flooding in any given year.

Floodplain Management - A term applied to the full range of public policy and action for ensuring wise use of the floodplains. It includes, but is not limited to, collection and dissemination of flood control information, acquisition of floodplain lands, enactment and administration of floodplain regulations including building codes, and construction of flood-modifying structures.

Floodplain Regulations - A general term applied to the full range of codes, ordinances, and other regulations relating to the use of land and construction within designated floodplain limits.

Flood Profile - A graph of flood elevations along a stream.

Floodway - The channel of the stream and those portions of the adjoining floodplain which carry the floodwaters of a particular flood event.

Historical Flood - A flood known to have occurred in a specific area.

Maximum Known Flood - The largest flood known to have occurred on a stream or in an area.

Peak Discharge - The maximum rate of flow normally expressed in cubic feet per second (cfs) occurring during a period of high water.

Reach - Segments of a stream which mark boundaries such as the limits of a study, corporate limits, State or county lines, or other definable features.

Stream Mileage - Distance measured along the centerline of the stream from some designated point, usually where the stream enters into a large stream or body of water.

TVA Regional Flood - A flood comparable to the largest floods known to have occurred on streams of similar physical characteristics in the same general geographical region as that of the stream being studied. Ordinarily, the region considered is within a radius of 100 miles or less. Extraordinarily large and rare floods are not included in this determination.

TVA Structure Profile - A contour established by TVA along the Tennessee River and tributary reservoirs which marks the elevation above which structures are permitted on all lands which TVA either owns or on which TVA has certain landrights. In no instance are buildings for human habitation or any other form of development subject to significant damage permitted below this elevation. The profile is developed to avoid increasing the flood damage potential in areas affected by reservoir operations.

U.S. Coast and Geodetic Survey Levels - The vertical control surveys conducted to establish permanent elevation references.

Watershed - The area of land upstream from a selected point in the stream which "catches" rainfall and contributes runoff (flow) to the stream at the selected point.

REFERENCES

1. Tennessee Valley Authority, Floods on Big Creek, La Follette, Tennessee, Division of Water Control Planning, Report No. 0-5804, Knoxville, Tennessee, January 1958.

2. U.S. Water Resources Council, Guidelines for Determining Flood Flow Frequency, Bulletin 17A of the Hydrology Committee, Revised June 1977.

3. U.S. Army Corps of Engineers, HEC-2N Water Surface Profiles Generalized Computer Program, Hydrologic Engineering Center, Davis, California, June 1973.

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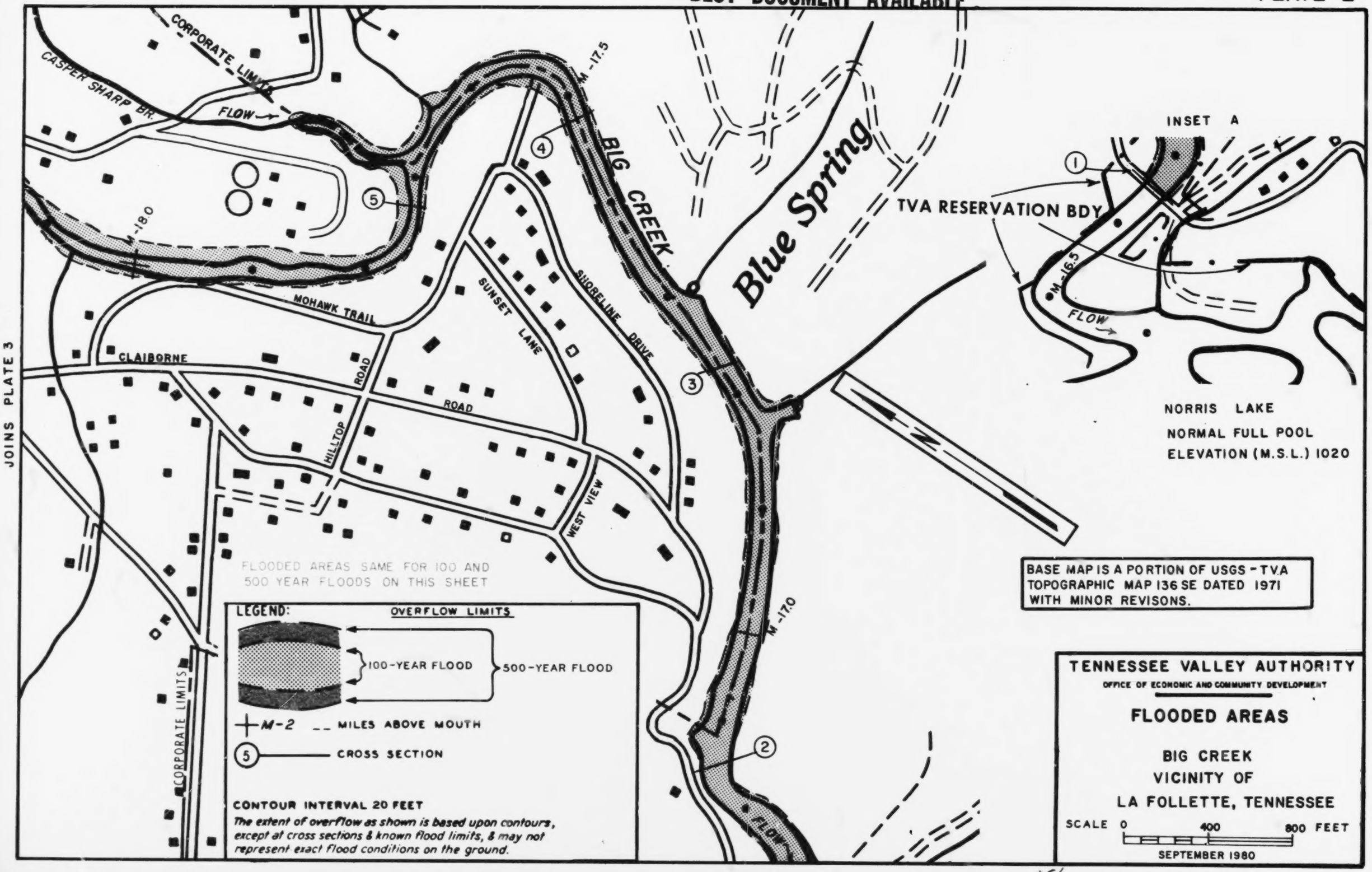
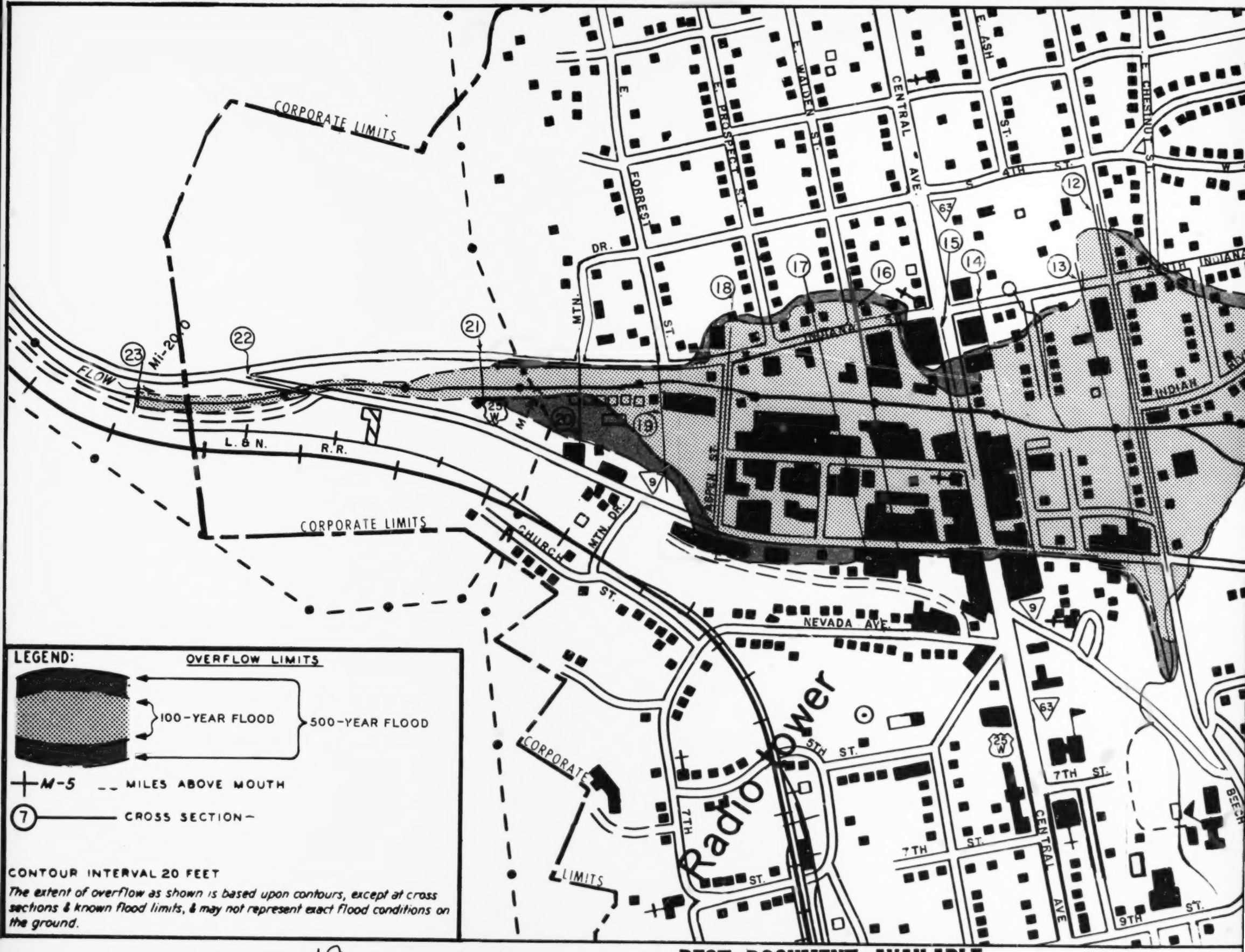


JOINS PLATE 3



LEGEND:

OVERFLOW LIMITS

100-YEAR FLOOD

500-YEAR FLOOD

M-5 -- MILES ABOVE MOUTH

(7) CROSS SECTION

CONTOUR INTERVAL 20 FEET

The extent of overflow as shown is based upon contours, except at cross sections & known flood limits, & may not represent exact flood conditions on the ground.

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BASE MAP IS A PORTION OF USGS - TVA TOPOGRAPHIC MAPS 136SE, AND 136NE DATED 1971 AND 136NW DATED 1973 WITH MINOR REVISONS.

JOINS PLATE 2

TENNESSEE VALLEY AUTHORITY

OFFICE OF ECONOMIC AND COMMUNITY DEVELOPMENT

FLOODED AREAS

BIG CREEK
VICINITY OF
LA FOLLETTE, TENNESSEE

SCALE 0 400 800 FEET

SEPTEMBER 1980

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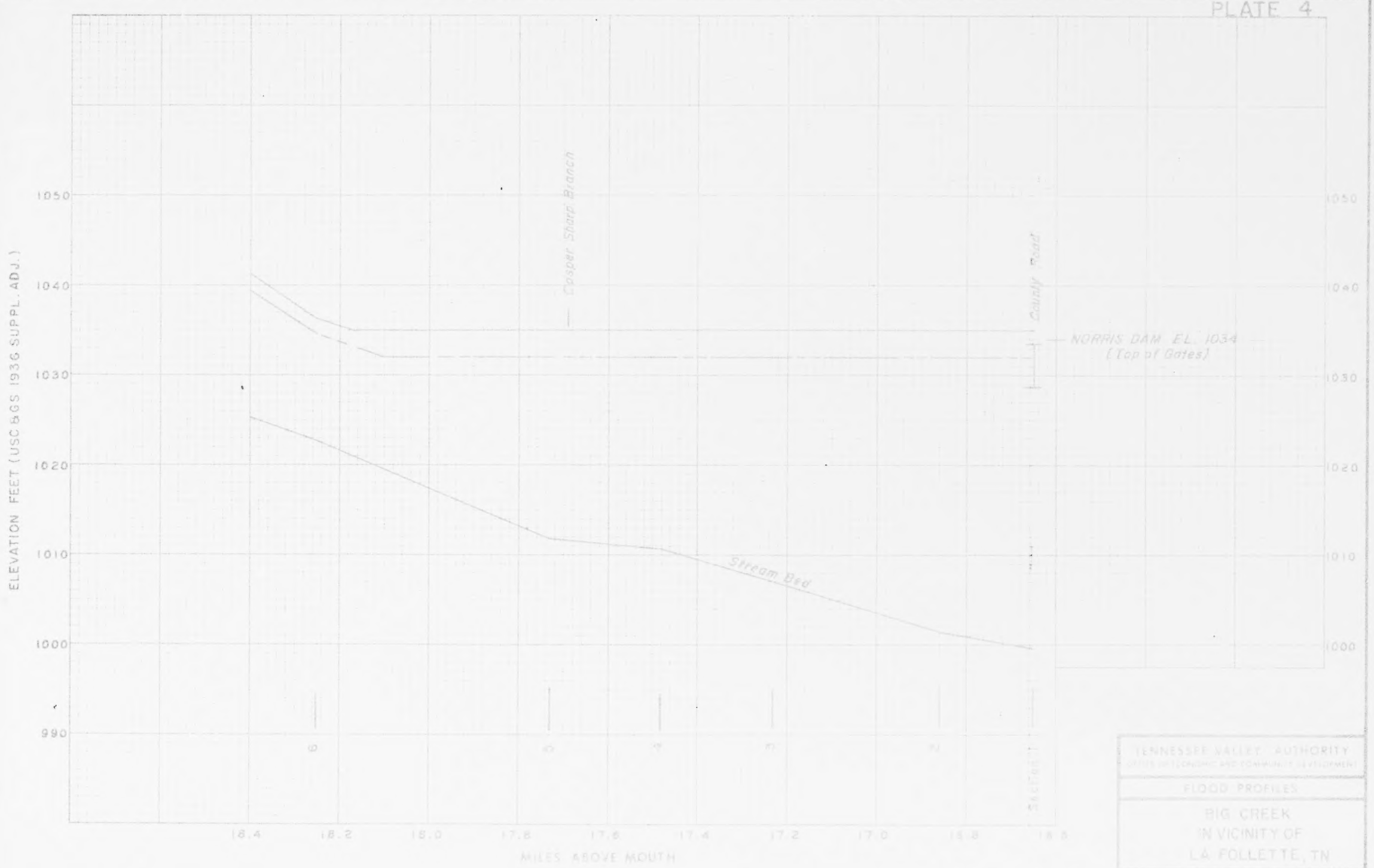
PLATE 4



TENNESSEE VALLEY AUTHORITY
OFFICE OF ECONOMIC AND COMMUNITY DEVELOPMENT

FLOOD PROFILES

BIG CREEK
IN VICINITY OF
LA FOLLETTE, TN

September 1980

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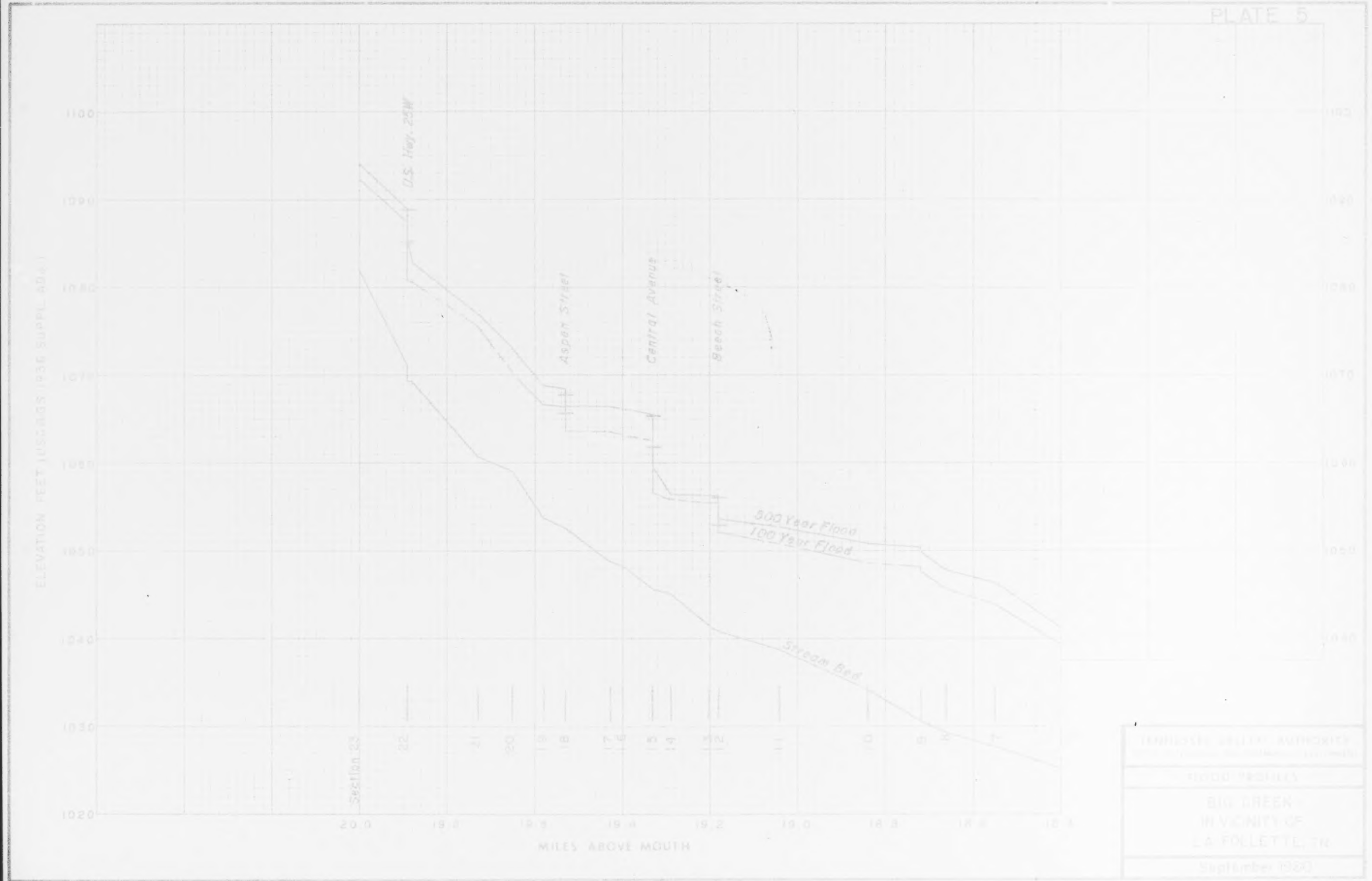
PLATE 5



TENNESSEE VALLEY AUTHORITY
FLOOD PROBLEMS
BIG CREEK
IN VICINITY OF
LA FOLLETTE, TN
September 1964

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APPENDIX

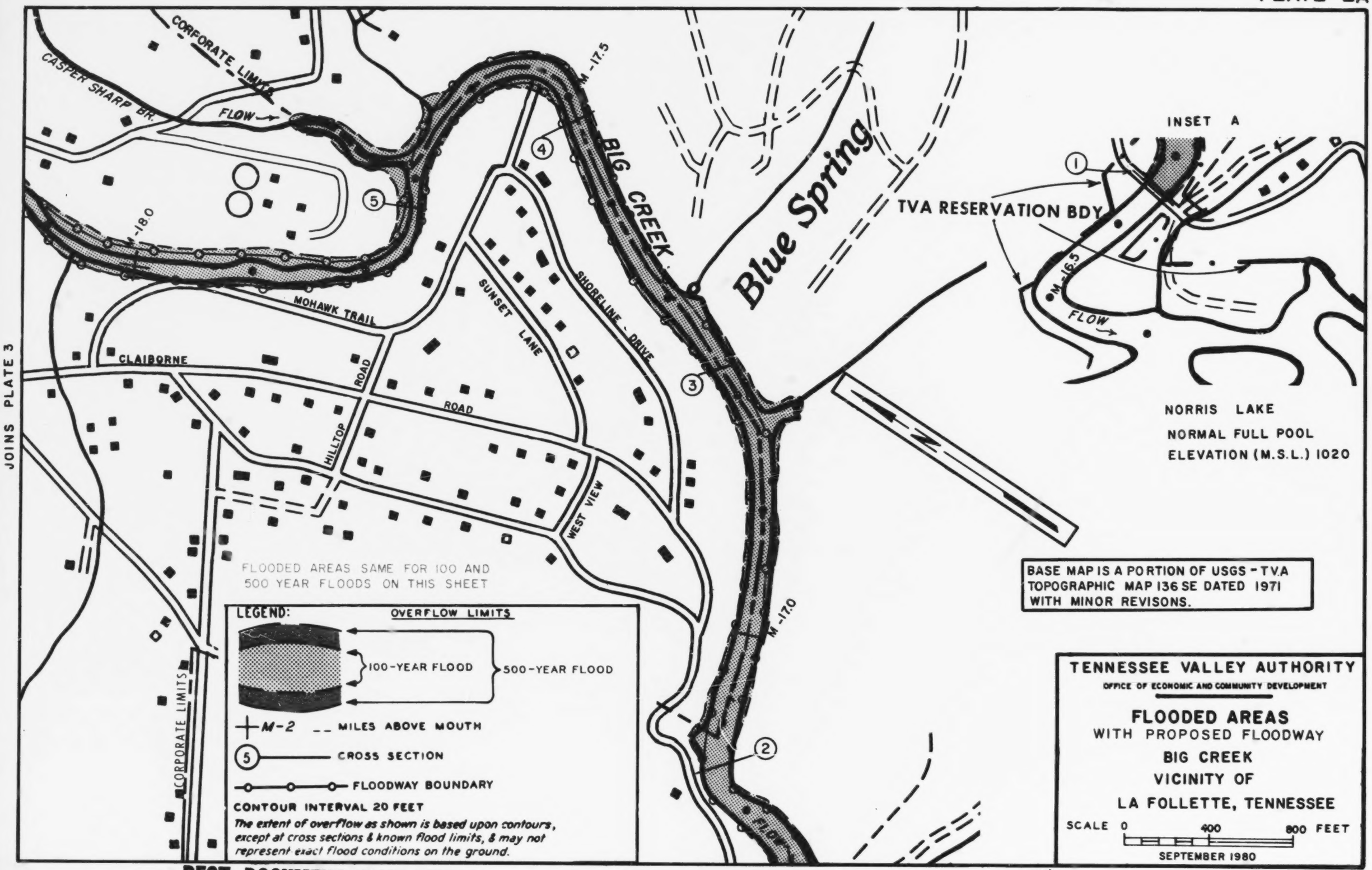
Table 1A

BIG CREEK 100-YEAR FLOODWAY

MILE	FLOODWAY WIDTH (Feet)	FLOODWAY SECTION AREA (Sq. Ft.)	FLOODWAY MEAN VELOCITY (cfs)	WATER SURFACE ELEVATION[2] WITH FLOODWAY	WATER SURFACE ELEVATION[2] WITHOUT FLOODWAY	DIFFERENCE
16.650 DS[1]	125.	1,013.	11.5	1,011.3	1,010.3	1.0
16.650 US[1]	125.	1,064.	10.9	1,011.7	1,011.2	0.5
16.860	130.	1,159.	10.0	1,014.5	1,014.5	0.0
17.230	92.	816.	14.0	1,019.2	1,019.2	0.0
17.480	130.	1,466.	7.7	1,024.2	1,024.2	0.0
17.730	95.	916.	10.7	1,025.6	1,025.5	0.1
18.250	100.	757.	12.6	1,034.6	1,034.6	0.0
18.550	120.	1,786.	5.3	1,044.9	1,044.0	0.9
18.660	100.	1,136.	8.3	1,046.5	1,045.6	0.9
18.720 DS	135.	1,946.	4.8	1,048.3	1,047.7	0.6
18.720 US	135.	1,955.	4.8	1,048.7	1,048.1	0.6
18.840	135.	1,530.	6.1	1,049.0	1,048.6	0.4
19.040	290.	2,310.	4.0	1,051.7	1,050.8	0.9
19.180 DS	400.	1,153.	7.9	1,052.7	1,052.0	0.7
19.180 US	380.	1,997.	4.6	1,055.9	1,055.5	0.4
19.200	380.	1,737.	5.2	1,055.8	1,055.4	0.4
19.290	180.	1,092.	8.3	1,056.8	1,055.8	1.0
19.330 DS	145.	561.	16.0	1,056.6	1,056.6	0.0
19.330 US	145.	1,175.	7.7	1,062.2	1,062.2	0.0
19.400	130.	982.	9.2	1,062.8	1,062.8	0.0
19.430	130.	1,019.	8.8	1,063.3	1,063.3	0.0
19.530 DS	80.	668.	13.3	1,064.3	1,063.3	1.0
19.530 US	80.	798.	11.2	1,066.4	1,066.4	0.0
19.580	77.	707.	12.6	1,066.7	1,066.7	0.0
19.650	90.	725.	12.3	1,070.4	1,070.1	0.3
19.730	90.	1,056.	8.3	1,075.6	1,075.6	0.0
19.880	80.	766.	11.5	1,081.1	1,080.7	0.4
19.890 DS	80.	462.	19.0	1,080.9	1,080.9	0.0
19.890 US	76.	974.	9.0	1,087.4	1,087.4	0.0
20.000	79.	590.	14.7	1,092.3	1,092.3	0.0

1. Downstream and Upstream at bridges.
2. Feet above mean sea level.

BEST DOCUMENT AVAILABLE



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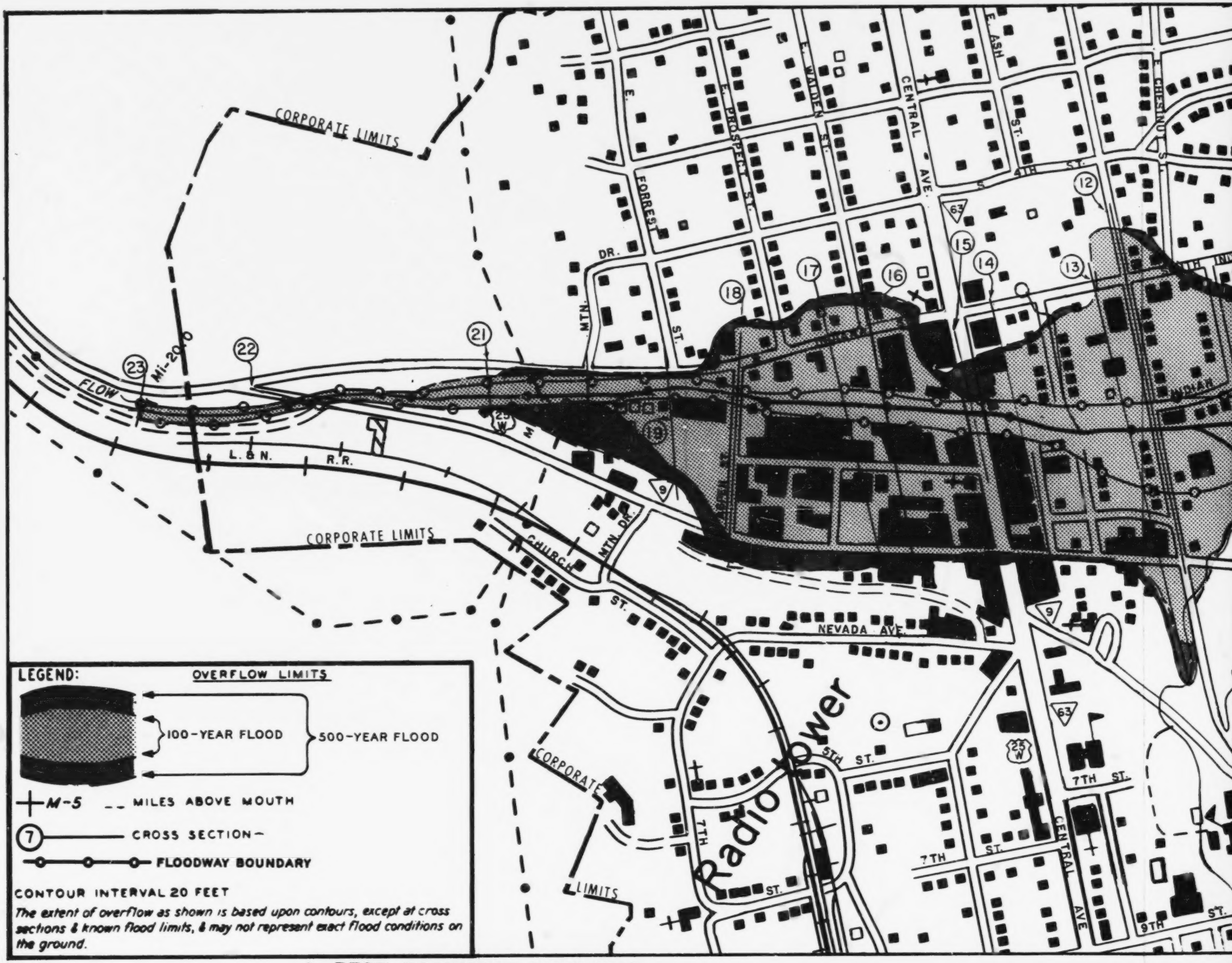

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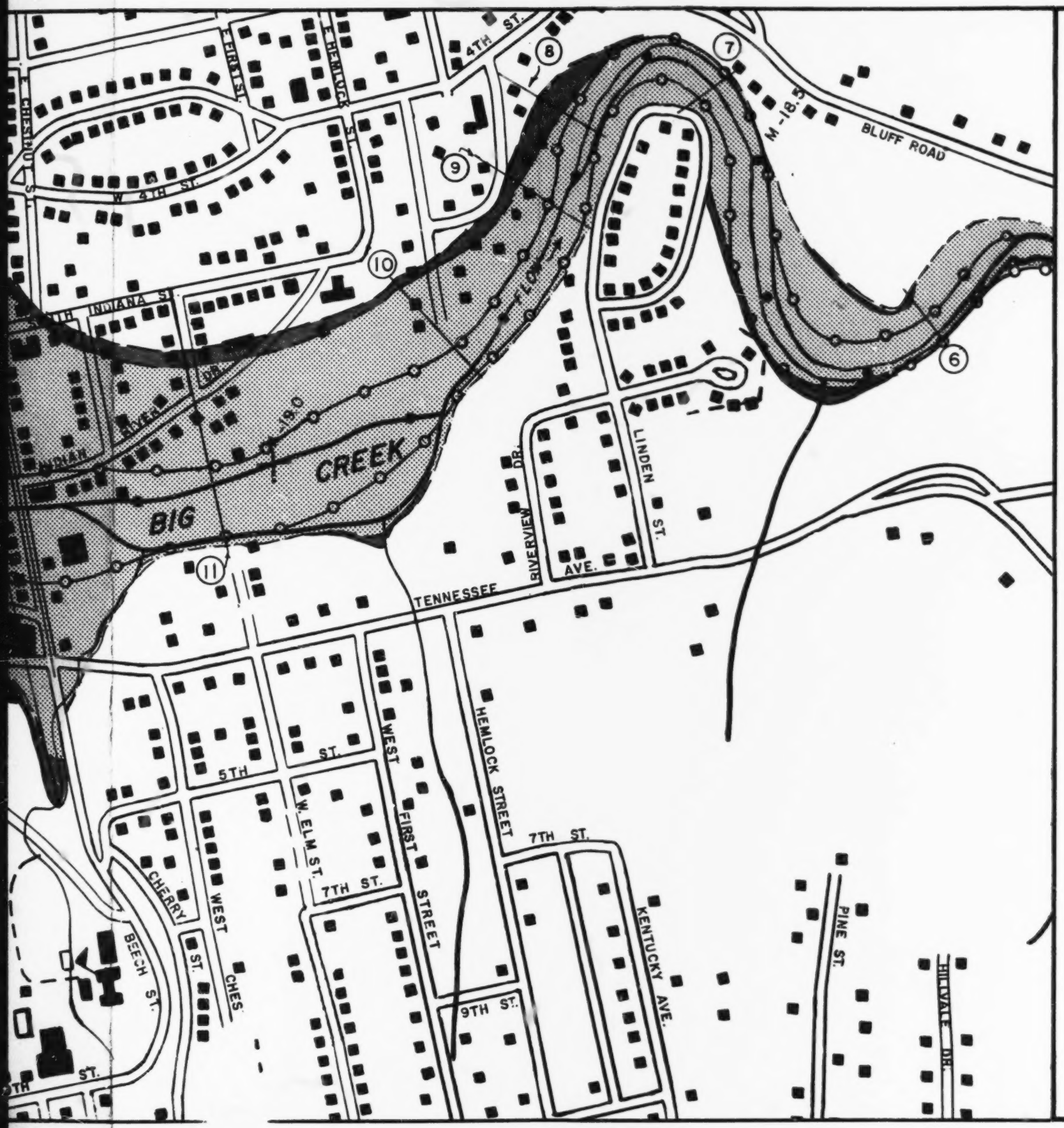
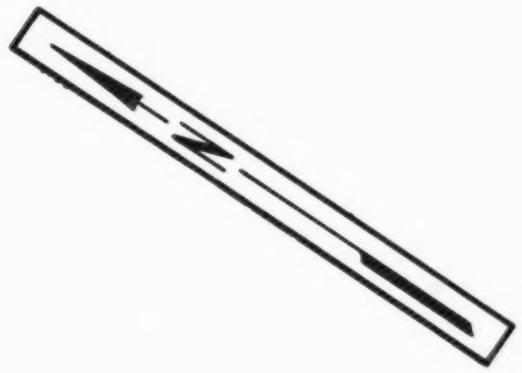


BASE MAP IS A PORTION OF USGS - TVA TOPOGRAPHIC MAPS 136SE, AND 136NE DATED 1971 AND 136NW DATED 1973 WITH MINOR REVISONS.

JOINS PLATE 2



TENNESSEE VALLEY AUTHORITY

OFFICE OF ECONOMIC AND COMMUNITY DEVELOPMENT

FLOODED AREAS WITH PROPOSED FLOODWAY

BIG CREEK

VICINITY OF

LA FOLLETTE, TENNESSEE

SCALE 0 400 800 FEET

SEPTEMBER 1980

BEST DOCUMENT AVAILABLE